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Infrastructure Management, Covering Your Assets, and the Great GASB 34

See Editor's Note on back page

By Roger Chappell, Technology Integration Engineer, WST2 Center

In this article I would like to give a brief introduction to Asset Management Systems (AMS) and GASB34, but first we will begin with Infrastructure Management (IMS).

I have been a proponent of Infrastructure Management for a number of years now and still fail to come up with a succinct definition of what an IMS really is. The best I can come up with for a one-line description is: *A holistic approach to managing complex infrastructure systems in order to maximize their efficiencies and resources for the benefit of all users.* I know that sounds as clear as mud, but I think it is a good starting point.

Let's start with the word *holistic*: The American Heritage Dictionary defines it as *emphasizing the importance of the whole and the interdependence of its parts.*

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GIS/GPS: More Than Alphabet Soup

By Roger Chappell, Technology Integration Engineer, WST2 Center

Many people today seem to put GIS (Geographic Information Systems,) and GPS (Global Positioning System) into the same alphabet soup, when in fact they serve very different functions. In this article I hope to clear the water a little and show how these uniquely different systems work very well together.

There are four general types of GPS receivers:

1. Navigation Grade
2. Mapping or Inventory Grade
3. Survey Grade
4. Specialty and Military Grade

In this article I would like to narrow our focus to mapping or inventory grade GPS receivers, and their role in a GIS. This is one of the fastest growing applications of this new technology, and it carries with it the most profound impacts on how we will manage corporate

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Infrastructure Management

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Holistic is the birds-eye view of how your organization functions as a whole, and how it resides and interacts in an environment of other diverse organizations. Let us take your roadway system for example. Your Pavement Management System (PMS) is one small part of the whole transportation network. Its function is to preserve your roadway network at some given level of performance. It identifies when a roadway should have maintenance and rehabilitation and at what point in time it is the most cost effective. Using a Management System like Pavement Management, Maintenance Management, Safety Management, or Bridge Management is a proven, cost-effective way to manage your resources.

One of the problems of these "stovepipe" management systems is lack of integration and communication.

Back to our example of a PMS, let's say you spend a lot of time, effort, and money to inventory, evaluate, and analyze a section of pavement. The crystal ball algorithms say today is the most cost-effective day to spend your limited resources on preserving this piece of roadway. So you hire someone do the rehabilitation (we won't talk about the ridiculous sum of money that you had to pay them in the process), and now the work is completed. Ahhha, so now you sit back in your easy chair smugly congratulating yourself on what a fine job you did managing your pavement. As you sit there sipping your coffee and glancing at the nightly newspaper, you realize that the cover story is about a new 48-foot sewer line that is going to run right down the middle of your still-steaming asphalt. Sitting there still in shock, coffee all over the carpet, you murmur to yourself, "there must be a better way!" The good news is that there is a better way! That better way is Infrastructure Management.

The problem with implementing Infrastructure Management is that it is more than just buying some fancy new software program. It is new ways of doing business. Keep in mind our definition of holistic: emphasizing the importance of the whole and the interdependence of its parts. It is looking outside our box and seeing our role in the whole of the organization and our interdependence on other members. It is also more then somebody's nice little bell curve or algorithm. It goes to the heart of why we do what we do, whom we do it for, and how we can do it better. A big part of Infrastructure Management is simply good old-fashioned communication.

In the scenario of the pavement manager with the sewer line running down the center of the freshly paved road, simply working with the sewer department could has saved much effort and money. Do you need a big fancy database system or GIS to do that? No. Simply sharing your six-month, one-year, and/or five-year plans with each other would have worked. Databases and GIS's have their place in the management process, but they are only a tool to use and not a substitute for good management practices. Many of our databases and GIS's were built around the stovepipe system that they serve. In order to be able to analyze and evaluate and make informed decisions regarding the whole infrastructure, these systems need to be integrated with one another.

That is easy to say, but much harder to actually accomplish. In the last issue of the *T2 Bulletin* there was an article covering the Geospatial Framework Committee. This is an interagency group of people trying to reach a consensus on a common framework for GIS users to share data across governmental boundaries (http://framework.dnr.state.wa.us). It is projects like these that will help make Infrastructure Management more of a reality.

The reason for discussing projects like these and concepts like Infrastructure Management and Asset Management is that many of the agencies reading this article are either contemplating or implementing some form of Infrastructure Management. Those agencies that aren't will need to start thinking about it and will need a direction to move in.

Before we move on to talk about Asset Management, I need to mention one of the motivating factors driving the need to move to Infrastructure/Asset Management, besides making good business sense. We need to talk about GASB 34.

GASB 34

GASB stands for Governmental Accounting Standards Board. The mission of the Governmental Accounting Standards Board is to establish and improve standards of state and local governmental accounting and financial reporting that will result in useful information for users of financial reports and guide and educate the public, including issuers, auditors, and users of those financial reports.

This Statement (GASB 34) establishes financial reporting standards for state and local governments, including states, cities, towns, villages, and special-purpose governments such as school districts and public utilities. It establishes new financial reporting requirements for state and local governments throughout the United States.

Governments should report all capital assets, including infrastructure assets, in the government-wide statement of net assets and generally should report depreciation expense in the statement of activities. Infrastructure assets that are part of a network or subsystem of a network are not required to be depreciated as long as the government manages those assets using an asset management system that has certain characteristics and the government can document that the assets are being preserved approximately at (or above) a condition level established and disclosed by the government.

The requirements of this Statement are effective in three phases, based on a government's total annual revenues. Governments with total annual revenues (excluding extraordinary items) of $100 million or more (phase 1) should apply this Statement beginning after June 15, 2001. Governments with at least $10 million but less than $100 million in revenues (phase 2) should apply this Statement beginning after June 15, 2002. Governments with less than $10 million in revenues (phase 3) should apply this Statement beginning after June 15, 2003. Earlier application is encouraged. Governments that elect early implementation of this Statement for periods beginning before June 15, 2000, should also implement GASB Statement No. 33, Accounting and Financial Reporting for Nonexchange Transactions, at the same time. If a primary government chooses early implementation of this Statement, all of its component units also should implement this standard early to provide the financial information required for the government-wide financial statements.

Prospective reporting of general infrastructure assets is required at the effective dates of this Statement. Retroactive reporting of all major general governmental infrastructure assets is encouraged at that date. For phase 1 and phase 2 governments, retroactive reporting is *required* four years after the effective date on the basic provisions for all major general infrastructure assets that were acquired or significantly reconstructed, or that received significant improvements, in fiscal years ending after June 30, 1980. Phase 3 governments are encouraged to report infrastructure retroactively but may elect to report general infrastructure prospectively only.

To make a long story short, all governmental agencies will need to take a closer look at how they manage the infrastructure they have been entrusted with and how they communicate the results to the public. This was intended only as a brief introduction to the topic and to relate to its role in Asset Management in general.

Asset Management

So that leads us to our final topic, Asset Management. Asset Management builds on the framework of Infrastructure Management and melds into it the accounting aspects for management of the capital investments.

Some of the questions that Asset Management asks are:

- What is it, where is it located, and what is it worth? This is simply an inventory of all fixed assets that make up the infrastructure at a certain level of capital investment. For this example we will use "things" worth over $25,000, i.e., roadways, bridges, illumination, traffic signals, and waste water piping systems.
- What has it cost both initially and historically to provide for this component?
- What will it cost to maintain it at some level of performance into the future?
- Is it sufficient to meet the need for which it was intended?
- What is its life span and depreciation rate?

I hope you can begin to see some of the difference between Asset and Infrastructure Management. I would like to leave you with a couple of good URL's for Asset Management.

The first is public works.com. If you type "asset management" into their search engine you will find a lot of resource relating to all aspect of the topic from a publics works perspective.

http://www.publicworks.com/content/homepage

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The second is the Office of Asset Management in FHWA: http://www.fhwa.dot.gov/infrastructure/asstmgmt/

They also have a very good little publication called *The Asset Management Primer*. It can be downloaded in a PDF format from the "resources" section of their site.

I hope this introduction has fueled your curiosity for investigation into some of the challenges that lay ahead.

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GIS/GPS: More Than Alphabet Soup

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data in this new millennium. Whether you are managing a sign inventory, a striping log, or a wetland, GIS may be just the tool for you and GPS may be the key that will help you to use it.

Before we dive in, I am going to indulge myself in a brief tirade on what I call "technobabble." I find that one of the most difficult elements of applying new technology is understanding the terminology.

Words should clarify and communicate the concepts involved in the technology. All too often they seem to be abstract, ill chosen, or adapted from another field. One of the problems is that these systems are so new and dynamic that the words with the exact meaning of the new concepts don't always exist. Words are then created or borrowed from other disciplines that describe similar concepts and their meaning is expanded on. As a result, words for the new technology may have a subtle, or not so subtle, difference from older established fields. Add to this the dynamic state of the technology itself and you have a real potential for miscommunication between disciplines and individuals. At times, it is like learning another language where the meaning of the words change as subtly as dialects do within a language. Words such as "geospatial coordinates" may paint a very different picture to a geodesist than in the mind of a cartographer or GIS manager. As you read this article you will encounter words that will be defined by the surrounding text. Your agency may use different terminology to describe similar concepts and functions.

> Whether you are managing a sign inventory, a striping log, or a wetland, GIS may be just the tool for you and GPS may be the key that will help you open the door to the world of GIS.

Another problem is that you won't find most new technical words like geospatial in a regular dictionary, so there isn't a easy source of standardized definitions.

The world of GIS is a melting pot of various disciplines, cultures, and data types. The common language is geospatial coordinates (coordinate geometry, i.e., latitude, longitude and elevation).

I mention the topic of technobabble in hopes that it will alert you to its existence and the ramifications that multiple definitions of terminology can have as you encounter the different dialects of technobabble within your agency.

What is a GIS?

In its simplest terms, a Geographic Information System (GIS) is an electronic map with information on it.

If you were to plot an outline of the State of Washington on a piece of paper and place it on a table, you would have defined a geographic area. Next, assume you were to take sheets of clear plastic with information on them about this geographic area and lay them on top of the map in layers, one on top of the other. Information on the subsequent layer is displayed in three formats—points, lines and polygons—depending on the type of data represented.

For example, some layers may have topographical information showing hills, valleys, bodies of water, etc. Other layers may have county boundaries, tribal reservations, forests or wetlands. These enclosed shapes, or areas, are commonly referred to as "polygons" (a geometric plane consisting of three or more sides).

Other layers may have linear representations of roads, striping logs, railroads, rivers, streams, etc. These are referred to as "lines."

Still other layers may have "point" information, such as cities, airports, signs, culverts, and mileposts. All information placed on a map (geographic) must be some type of point, line, or polygon.

Instead of using paper and plastic layers, a GIS is a computerized system that helps you store, manage, analyze and present your geographic information electronically. Thus the name GIS is a compound acronym built from geographic (map or area), information (layers of data), and system (the computerized software system).

The glue that holds all these layers of information together and orients them properly to themselves is georeferencing. Georeferencing is a referencing system based on a X, Y, and sometimes Z (length, width, height) coordinate system. For example: longitude, latitude, and elevation. I say sometimes Z, because most GIS's currently operate in two-dimensional space not three-dimensional. To help you understand GIS terminology, the Association for Geographic Information has a GIS dictionary and other tools (for example, an acronym list) on their web site at:

http://www.geo.ed.ac.uk/agidict/welcome.html

They define georeference as "To establish the relationship between page coordinates on a map and known real-world coordinates."

What Makes GIS More Than Just a Pretty Drawing?

In a GIS, someone has taken these graphical elements and other information related to the map and referenced them to locations in the real world. What was once an artistic representation of the real world is now a "smart" map because it knows where in the real world its layers are located geospatially. All the layers in your GIS are glued together because they all represent the same geographic locations. This takes all the layers of information and places them over each other so all common points are in alignment. For example, the point that a river intersects with a roadway (on the river layer), now matches the point that the roadway intersects the river (on the roadway layer), and both those points match the actual location in the real world.

A GIS can "speak" other languages besides XYZ, such as LRS (linear referencing system), but again the common language to both is georeferencing.

In a GIS you can turn the layers on and off to help display and analyze your data in various combinations and in a common format. It also provides a common language to share your data with others and to analyze your data against factors that are hard to see in a tabular format, such as a database.

For example: If I have a stretch of roadway (line) that quickly deteriorates after paving and I bring that roadway up in a GIS, I can place readings from a deflectometer on top of it (point data). This information may lead me to turn on the soils and wetlands layer (polygons) underneath it. Since these lines, points, and polygons are all georeferenced to the same geospatial location, I can quickly align all the information and analyze the relationships between them. Now as I analyze my layered data, I discover that the roadway is failing because of the surrounding environment, not because of the materials that were used in the paving construction. This is only one of many possible applications. I am sure that you can see the value of such a system.

What Does GIS Have to Do With GPS?

GPS is a satellite based measuring system. As a GIS can be described using layers of paper and plastic, GPS can be characterized as a high-tech, three-dimensional measuring tape. If you pulled 12,600 miles of tape from four tape measurers in geosynchronous orbit above the earth, they should intersect at a measurable location on the surface.

GIS specializes in organizing and analyzing data, while GPS specializes in the ability to collect location data. You can use GPS as a stand-alone system to locate "things" (points, lines, and polygons) quickly, easily, and very accurately, depending the equipment and procedures you use. When GIS and GPS are integrated, they offer a very powerful combination.

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In fact, many of the inventory-grade GPS receivers today integrate some features found in a GIS. This seems to be a source of confusion to many today. Though these hybrid GPS systems have some of the functionality of a GIS, they lack the power and the full funcionality of a GIS workstation. On the other hand, even though the georeferencing of the base maps is getting more accurate all the time, a work station will never have the mobility and abilities that a GPS unit receiver has.

Some of the differences between GPS receivers are accuracy and functionality. An example of the basic navigation grade or recreational usage of GPS would be: "I found location XYZ and I can return to location XYZ whenever I want to." Navigation alone makes GPS a very handy tool.

The next step in using GPS is mapping or inventory grade usage. Now that you can locate XYZ, you may want to store information (attributes) that describes the things you have located there. For example: I am at location XYZ, and the data element I want to locate and describe is a box culvert. Most software will even allow you to break this element down even further to attributes about it, i.e., it is made of reinforced concrete.

It is at this point that you need to make a decision. If you will need to share, analyze, or present this data, then you will want to collect and store the data in a format that a GIS will recognize. If not, and the data will be used solely as an stand-alone application for internal purposes without the need of a GIS, then a simple database may be the most appropriate mechanism for storage and retrieval of your data.

There are several ways to accomplish this. Fortunately, GPS and GIS already speak the same language of geospatial coordinates. So communication between the two systems is relatively easy.

For this particular example I would like to look at using GPS to gather point data for a GIS. The reason for this is that it is the easiest path to travel. Data involving lines and polygons can get fairly complex. If you are using GPS to gather information about things that are going to be represented as lines or polygons, I would recommend involving your GIS manager and possibly a cartographer in your project. Even "point" data can become tricky at times. For example, a city at one scale may be a point on the map, but as you zoom in, that point may cover a large area and become a complex polygon.

Knowing a little bit about what map scales are available to plot your data is important. With GPS we have at our disposal a tool that can quickly and accurately identify where in the world something is located. Depending on the type of receiver you use and the procedures you follow, the data you collect may be more accurate than the map you place the information on.

When you start to collect your data you will also need to know what coordinate system to use, such as latitude/longitude in decimal or degrees, or whether you will use state plane with NAD 83 or NAD 27 as your datum. It is best to involve your GIS support people in the early stages of your project, this will help resolve these formatting issues before you have a heavy investment into your data collect.

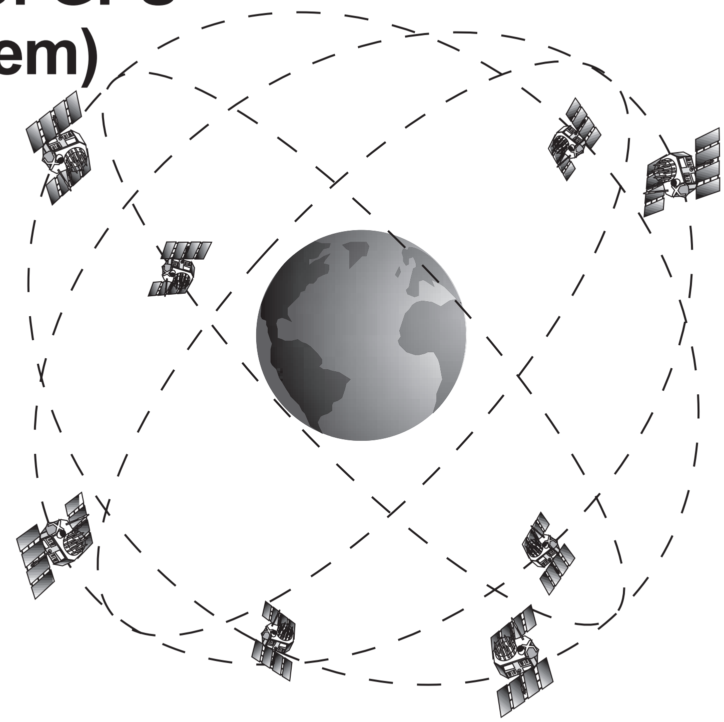
Data Collection May be the Most Costly Part

Your data collection may very well be the most costly part of your project, so my recommendation is to test, test, and test a sample again before full-scale collection. I've seen too many projects full of useless or difficult-to-use data because they were not fully evaluated before starting the collection process. This could have been avoided by simply working together and testing the results before full production. Changes after you have started data collection results in duplication of effort (collecting the same data multiple times) and data disparity (similar objects described or attributed differently), resulting in a lot of wasted time and money.

For past issues of the T2 Bulletin:

http://www.wsdot.wa.gov/TA/T2Center/T2Bulletin-archives/T2Bulletin.html

Unraveling the Mystery of GPS (Global Positioning System)



By Roger Chappell, Technology Integration Engineer, WST2 Center

Does one size fit all? What is the difference between the $99 GPS unit in the sporting goods store and the one a surveyor uses? There seems to be a lot of confusion today about GPS units. And rightly so, with prices ranging from $99 to over $40,000. I am asked these questions a lot.

I hope to answer these questions and to help demystify this strange new technology. The military, surveyors, and other select groups have been using this technology for a long time, but it has only been the last couple of years that the common person could afford to use it. It reminds me of the explosion in popularity of desktop PC's in the last 20 years. What was shrouded in mystery a mere 20 years ago is now a part of our lives and in many of our homes. Except now in the case of GPS there are more players in the game than Apple and Big Blue.

Will the next 20 years find geospatial coordinates as common as e-mail is today? Probably not, but hopefully it will be as easy to use. Along with looking at GPS, we will look at various peripherals like laser range finders, voice command, digital cameras, dead reckoning systems, and how these tools function together. We will also look at software systems, databases, and how to use your data in an GIS (Geographic Information System) environment.

Before we can begin to answer what type of unit is best for you, let's take a quick look at some of the different types of units available. I generally divide them into four types of systems:

1. Navigation grade receivers
2. Mapping grade receivers
3. Survey grade receivers
4. Specialty and military grade receivers

Navigation Grade Receivers

These units are *not* typically Differential Global Positioning System (DGPS) capable. We will discuss things that affect positional accuracy later, but in general, any unit that does not use DGPS can only pinpoint a location within a 100-meter circle.

Once you've selected a receiver in the 100-meter accuracy unit costs will vary depending on how many features are included with the unit. Navigation grade units are usually under a $1,000, with most of them under $500 depending on the features. Some include things like maps, data points, or line feature storage, and even satellite e-mail messaging.

Mapping Grade Receivers

These units should be DGPS capable and should be capable of five-meter to sub-meter (smaller than a one-meter circle) positional accuracy. These systems range from $1,000 to as high as $30,000, depending on the features, software, and peripherals included with the package. Most of these units come with a computer system and software that allows the user to input various types of data. Some systems include laser range finders, digital cameras, dead reckoning systems, voice command, and every type of test probe and meter imaginable.

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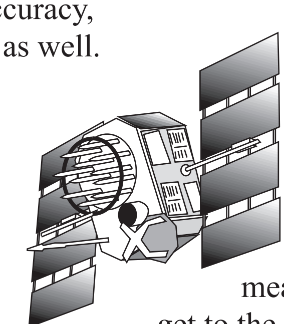
Survey Grade Receivers

These *are* DGPS capable and should be capable of centimeter accuracy or better. These units range from $5000 to $40,000 per unit. Achievement of sub-centimeter accuracy requires skill and training, and is best left to the GPS guru types for now. For example, there are RTK (Real Time Kinematic) systems that require a base station to be set up over a survey marker of known coordinates. There are radio links that must be maintained and the data must be corrected and verified.

As part of this series I plan to dedicate several of the articles to addressing some of the more complex issues involved with achieving this type of accuracy, and hopefully to some extent demystifying it as well.

Specialty and Military Grade Receivers

This is a general catch all category. The price and accuracy can vary dramatically. I throw this category in so we have a place to discuss things such as specialty receivers used for aerial photography, underwater positioning, and the like.



Military P(Y) Code Receivers that use the encrypted P code from the GPS satellites are only available to the military and some federal agencies. Receivers that aren't military receivers are called C/A (Civilian Access or Course Acquisition) code receivers. These P-coded receivers remove the effects of SA (Selective Availability) but may not compensate for ionosphereic, atmospheric, and other conditions. Even without SA, these receivers are only accurate to between three and nine meters (without differential correction).

So what is SA (Selective Availability)? The greatly simplified version is: The Department of Defense controls the GPS satellite system. Each satellite has a very accurate atomic clock that broadcasts the current time, and your receiver also has a clock built into it. By comparing the time from the GPS satellites (when it left space), when it got to you (the clock in your receiver), and knowing that the signal travels at a constant velocity at the speed of light, it is simple math for the computer in your receiver to figure out how far away that satellite is from you. It takes the signal from three or more satellites to triangulate a position in space (three satellites for an XY position, four or more to add Z). This is called trilateration. Everything about the process comes down to time and velocity.

Here's where the mystery comes in. There are invisible forces acting on these signals that change the velocity (ionospheric and atmospheric) or time (clock errors or human intervention). If you had an atomic clock in the vacuum of space with no interference, in theory, the measurements could be perfect.

Even though the satellites are way up there (12,600 miles), you need pretty much line of sight. Unlike radio waves that you can pick up accurately inside a building, interference as minor as leaves on a tree can stop the signal from reaching you. I've had people demonstrate that their equipment can pick up satellites within a building. What they are seeing is known as "multipath," or reflection. These multipath signals have reflected off something. This means the signal had to take a longer distance to get to the receiver, which in turn means it took longer time to get from the satellite to the receiver. This distorts the positional readings.

So back to SA. Since the Department of Defense controls this system, they also control its accuracy by controlling the time output from the satellites. This system was created and is operated by the Department of Defense for military purposes. Besides wanting to know where in the world things are, it is used for military targeting, and it is not a good idea for everyone in the world to have that pinpoint targeting ability, so they play with the time element a little bit. This also makes it a lot harder for someone on the ground to target a satellite, especially if it is moving and dodging in a virtual hundred meter circle.

Where does that leave the C/A code receiver people? I say, in great shape. We didn't have to install and maintain the system or pay rental on all these signals from space. We can use them for free, provided we have the right equipment. The Department of Defense gives us free access to accuracy that is within a 100-meter circle (95 percent of the time) and most of the time the circle is much smaller than 100 meters.

That is good enough for most hikers, hunters, boaters, and general-purpose navigation. Even better news is that in March 1996, President Clinton approved the phasing out of SA over a 10-year period. In theory, your cheap navigation receiver will get more accurate as time goes on. This will help the navigation people immensely. The bad news is that it still won't correct all possible inaccuracies. If you want sub-meter you'll still need DGPS.

The last question we will briefly cover is, what is DGPS, and how does the D (Differential) in DGPS help you? In a nutshell, DGPS is achieved by using two receivers. The first receiver is the one you bought to do your field work with. The second receiver may be a base station, DGPS vendor, or even a unit that you set up yourself. Whatever the case is, the second GPS receiver is placed over a point with a known coordinate value (such as a survey marker). Now that the receiver is at a known coordinate value, you can compare the signals that it is receiving against the coordinates where it is. The difference in distance between the receiver and the point projected by the GPS signal is your correction factor. From a very simplified view: if the signal coming into the GPS receiver determines that its location is 50 feet to the west and 25 feet to the north of where my coordinates say the receiver should be, then I need to subtract that distance from my measurements made in the field. Then it is just a matter of comparing the position that you receive in the field with the corrected ones from the base station and doing a little math. This is provided that the receiver in the field is looking at the same satellites that the base station is using. Some vendors use a network of base stations and adjust over long distances (baselines), then broadcast their corrections through a satellite to you.

There are two main ways that differential correction is accomplished" one is post processing, the other is real time.

Post Processing

In this scenario, the base station stores raw GPS position fixes, and software is used to compare the raw positions to the coordinate value of the receiver. This data is then placed in a log file or database and distributed. If you are using someone else's base station, keep in mind that there are various formats and position fix rates that are collected. So you will have to determine if their data will meet your needs. Look for meta data, the data about the site, base station and data that you are wanting to use. Then you will need to get the files you need to use to do the differential correction. Some base station information can be accessed directly over the Internet; for other information you may have to contact the base station operator. Once you have the base station files in hand, it is simply a matter of figuring out the software you bought that compares the two.

If you are new to GPS, it is a good practice to visit survey monuments as often as you can when collecting data in the field. This is a point with known coordinate values. I like to verify my data against known points whenever possible.

Real Time

Real time differential correction, is not to be confused with survey grade Real-Time Kinematic (RTK systems. Using real-time differential correction is basically the same concepts as stated above. The big difference is that your receiver is in constant contact with a base station through radio or satellite links, making the differential corrections on the fly in real time. Some equipment even allows you to do both real time and post processing differential correction on the same data.

There are free broadcast corrections available in many locations, and there are companies that sell these services as well. It is up to you to find the system that works best for you.

I hope this gives you a starting point for answering the question "Which type of unit is best for me?" Any of the above systems will tell you where in the world you are, and some will even tell others what you found when you got there. The cost of the equipment will vary depending on the accuracy of the equipment, the features included, and the size of the unit. Sometimes you may pay a heavy price to get the features you want. Some units do it with great accuracy and some with great complexity, but as with any technology, it is getting smaller and easier to use everyday.

2001, A Geospatial Odyssey

By Roger Chappell, Technology Integration Engineer, WST2 Center

With the dawn of the new millennium I pause and ask myself, where do we go from here? I wish I could get a definitive answer from HAL the computer on this one. Last year we talked about data inventory systems, GIS, GPS, Infrastructure Management, Asset Management, and GASB 34.

With the speed that technology changes you don't need a crystal ball to prognosticate that change is inevitable. Looking back over the past ten years gives us a serious wake-up call to just how fast technology is moving. It also provides a reference for looking into the future.

Here are a few things we see in the near future:

- GASB 34 (Governmental Accounting Standards Board Statement 34) is coming, and to some extent it will impact every governmental agency. GASB 34 requires financial accountability in the reporting of governmental assets.
- Asset Management is a concept many governmental agencies are adopting. It builds on Infrastructure Management by adding the dimension of financial accountability. Whether it is money, workforce or materials it makes good business sense to know how much you have, its current status, and how it is performing. Also, by having an Asset Management system in place, an agency will be in a position to use the modified approach to meet GASB 34 reporting requirements.
- Infrastructure Management makes good business sense for local agencies. It is defined as "a holistic approach to managing complex infrastructure systems to maximize their efficiencies and resources for the benefit of all users." It provides a cohesive integration of pavement, safety, maintenance, bridge preservation, wastewater, solid waste removal, and other management systems.
- GIS (Geographic Information Systems) are great tools to analyze and communicate various aspects of these complex systems and to see their relationship to other systems that share common geographical space.
- GPS (Global Positioning System) is another great tool for locating "things" and their relationship to a known location on the surface of the earth.

We haven't even begun to discuss things like IMS (Internet Map Serving), B2B (Business to Business), B2C (Business to Customer), internet portals, and optimizing web applications over your intranet and extranet systems.

What is the future for these technologies? The mechanisms to implement these technologies will be getting smaller and faster and will be constantly changing. Many of you reading this remember the Apollo lunar landing. Today, you have sitting on your desk and your homes, a computer that is more powerful than the one used to put those men on the moon. Whatever the next five, 10, or 15 years hold for us, one thing is certain: Change is inevitable.

What I write is not even cutting edge technology; most of it is tried and true. For example, the military has been using GPS for many years. Some land surveyors have been using it for about 10 years. Some surveyors are already on their second or third generation of equipment. Even though it was only popularized a couple of years ago for the general public, GPS has been in use for many years. I saw them put GPS on a D8 Cat a few years ago. Both the Cat and the GPS were old technology. I find that much of the "new technology" is simply an improvement of an existing technology, an integration of existing technologies, or a new application for an existing technology.

As in the Cat/GPS scenario, even when equipment or principles are tried and true, as they are applied in new ways there will be a learning curve to overcome in the new application.

For example, what happens when your new GPS spray rig is operating under a heavy tree canopy and you lose satellite lock? Does this mean GPS doesn't work? No, it only means that it won't work well under a heavy tree canopy. If the GPS data is important, then you may need to look at other complementary technologies such as inertial guidance systems, or wait until fall when the leaves have fallen from the trees.

Inertial guidance systems are modified versions of guidance systems like the ones used in rockets. They take a reading from GPS satellites and continue tracking positions using some arrangement of gyroscopes and clinometers with a timer or DMI (distance measuring instrument) until another GPS reading is obtained. If this doesn't work for you, you may be forced to use a LRS (Linear Referencing System) such as a milepost system.

What was once considered rocket science is now finding its way onto your desks, into your vehicles, and into your homes. A lot of the things scientists are thinking up today will in some form be our tools of tomorrow and they will be smaller, cheaper, more powerful and disposable.

I have built several sophisticated integrated systems myself. Here are a few nuggets I have gained from my own experience in the process.

Plug and Pray

Plug and play is an oxymoron. A more accurate name is "plug and pray." Vendors will promise the world, but don't buy unless you are willing to roll up your sleeves and do some of the research and development yourself.

Buy Off the Shelf

I like to buy off-the-shelf technology when I can. Some "black boxes" have a lot of sophisticated technology built into them, and I like to throw them away and grab a new one easily if I need to. You don't always need to know everything about a box to use it, but you do need to know enough to determine when and if it is working properly in your application. For example, you don't need to know the detailed inner workings of satellite communications or cellular technology to place a call on your cell phone.

Test! Test! Test!

My motto for using "black box" technology is test, test, and test it again before full production. It may look good on the drawing board or workbench but you need to test it in the environment that it will be expected to perform in. Once it is in production it is much harder to make changes. When you test, be sure that the results are consistent and accurate.

Not All "Black Boxes" are Created Equal

Not all boxes are created equal, even if the manufacturer says they are, or even if they look the same. The one you bought six months ago may have sat on a vendor's shelf for six months before you bought it and may be subtly different from current versions.

Keep it Simple

Keep things as simple as possible. Although there are always fancier or more efficient ways of doing things, the added sophistication usually increases complexity and potential for problems.

Use Proven Tools

Choose proven, rock-solid applications whenever possible. I try to wait until a component has proven itself as an industry standard before integrating it into a complex system. The individual components of a system tend to be in constant state of dynamic evolution. The more you integrate complex subsystems, the more dynamic the rate of change is in the entire system. You can save yourself a lot of grief if the components you elect have their "bugs" worked out already.

Hold on to Things Loosely

Since components are in constant evolution, you need to be flexible. I try not to hold on too tightly to any particular component of the system. It's going to change tomorrow.

Keep Track of the True Age of Your System

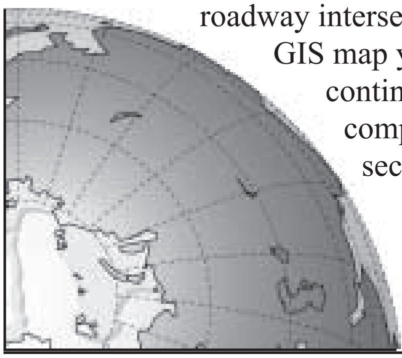
If dog years are seven years for every human year, then "computer years" are about twenty years for every human year. A four-year-old computer is equal to an eighty-year-old human when it comes to the latest technologies. I try to maintain the system at some level of "computer years," say, 60 computer years old,

continued on next page

depending on the system's purpose. Much of this is decided by your individual budget constraints, but should be considered in the longevity of any technological investment.

Keep Your Mind Open and Eyes Sharp

I have had some of my greatest successes from combining technologies from unrelated disciplines. In one of my recent experiments I took a series of still photographic images and stitched them together to form a 360-degree panoramic view. The software was easy to use and I got a free download from the web. Next I used GPS to get a location of the camera and then dropped the composite image into a GIS as a theme. The result? When you click on a roadway intersection located on the GIS map you are able view a continuous panoramic picture completely around the intersection as if you were standing in the middle of it looking out. At times integration of existing technologies can yield amazing results with little effort.



In conclusion, I would like to leave you with a quote from Theodore Roosevelt that I have hanging by my desk. I have read it many times in the midst of technology integration projects.

"It is not the critics who count; not those who point out how the strong stumble, or where the doers of deeds could have done them better. The credit belongs to the people who are actually in the arenas, whose faces are marred by dust and sweat and blood; who strive valiantly; who err, and come short again and again, because there are no efforts without error and shortcoming; but who do actually strive to do the deeds; who know the great enthusiasms, the great devotions: who spend themselves in a worthy cause, who at the best know in the end the triumph of high achievement, and who at the worst, if they fail, at least fail while daring greatly, so that their place shall never be with those cold timid souls who know neither victory nor defeat." —Theodore Roosevelt.

Some Great Web Sites for GPS and GIS Education, Information.......

http://www.trimble.com/gps/

http://www.colorado.edu/geography/gcraft/notes/gps/gps_f.html

http://www.aero.org/publications/GPSPRIMER/

http://tycho.usno.navy.mil/gpsinfo.html

.... Resources and Free Downloads

http://www.cnde.iastate.edu/gps.html

http://www.ngs.noaa.gov/PC_PROD/pc_prod.shtml

Project Updates

Water Drainage from Thaw Basins, Project No. 01-47

Project Description

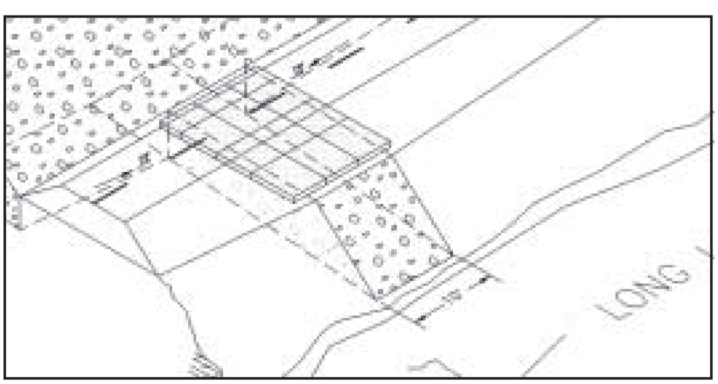
Embankment construction on top of frozen soil disturbs the ground thermal regime and results in water accumulating below the embankment toes, producing thaw basins. This triggers side-slope instability and embankment settlement. Water needs to be diverted and removed from below the embankment in order to maintain the integrity of the earth structure. This project will explore the possibility of using, for instance, gravel columns, geosynthetics, or an innovative ditch construction method. It will also develop criteria for use by DOT&PF engineers and others. The final product of this research will be in the form of drainage-related design criteria that will be added to the department's current embankment design criteria.

Project Objectives

- Find innovative technique(s) to divert and remove accumulated water at embankment toes.
- Reduce embankment maintenance costs.
- Increase safety for the travelling public by eliminating wide-open longitudinal cracks that now occur along the embankments.

Project Status

The project will be going out to bid. Northern Region geotechnical engineers are preparing a request for proposals, and will ultimately also review the RFP responses. The estimated completion date is December 31, 2003. Direct questions and comments to Steve Saboundjian, Project Manager, at 807-451-5322 or steve_saboundjian@dot.state.ak.us.



Reliability of Power Sources for Remote Weather Observation Systems, Project No. 01-14

Project Description

Providing cost effective and reliable electrical power to operate remote avalanche-monitoringroad weather information system (RWIS) sites along coastal mountain ranges in Alaska is a significant challenge. DOT&PF's past attempts to establish remote, coastal alpine RWIS sites that harness solar and wind power in conjunction with battery storage have failed. The power demands of sensor heating elements, when combined with the very short winter daylight periods and rime ice formation on the wind foils and solar panels, reduced power output below what was necessary to recharge batteries. Various engine-driven power systems and thermal electric generators fueled by diesel or propane can provide reliable energy but require very large capital investments. They also have high annual operating costs attributed to on-site maintenance and fuel delivery by helicopter.

Recent developments in power source technologies promise greater reliability, yet remain untested and unproven in coastal, Alaska alpine environments. We don't know if we can develop and deploy these new power source technologies cost effectively.

Project Objectives

The goals of this study are to:

- Identify a cost-effective power generation system for remote, alpine Road Weather Information System (RWIS) sites that will provide reliable operation on a one-year or longer maintenance cycle in coastal Alaska alpine environments.
- Identify barriers to cost-effective implementation and suggest techniques or additional research to overcome implementation barriers.

Project Status

Researchers are working to identify and test a promising power source at a coastal RWIS site in the

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Chugach Mountains near Valdez. The goal is to install the experimental equipment during the winter of 2001–2002. Direct questions and comments to Clint Adler, Project Manager, 907-451-5321 or clint_adler@dot.state.ak.us.

Impact of Ice Forces on Stream Bank Protection, Project No. 01-16

Project Description

DOT&PF commonly protects stream banks by placing rock riprap on stream banks in the vicinity of roads and bridges. The FHWA manual, HEC-11, "Design of Riprap Revetment," is the primary design guide. The HEC-11 procedure considers four factors:
1. the imposed tractive stress of the water flow,
2. the riprap material critical shear stress,
3. the bank inclination angle, and
4. the specific gravity of the riprap material.

The procedure defines a "stability factor" (SF) as the ratio of the resistive shear force to the imposed tractive force. Given the channel velocity and bank angle, hydraulic engineers use the primary design equation to calculate a nominal diameter (D 50) for the riprap material size. They adjust this D 50 value with two correction factors that account for the specific gravity and stability of the rock. HEC-11 makes only brief mention of ice damage consideration (Sec. 1.3, 4.1.1.1 and 4.1.3). It states that riprap designers do not generally need to consider ice forces, but if they judge them to be a problem, they can use an increased stability factor (SF). In the case of historical ice problems, the procedure recommends a SF of 1.2 to 1.5. The "normal" SF is 1.2. By comparison, gradually and rapidly varied flow and channel bends may raise the value to 2.0 and 1.7 respectively. HEC-11 equates ice impact with floating debris impact and also states that, in general, ice forces are not a problem and "…riprap sized to resist flow events will also resist ice forces."

DOT&PF has found that this rudimentary consideration of ice forces has not worked for Alaska streams and believes that riprap designs should consider other forces such as:

- anchor ice rafting and moving rocks,
- raft ice impact damage,
- raft ice pushup onto shore,
- ice jams causing velocity increase,
- rock encasement by ice with reduction of specific gravity, and
- increased longitudinal effective tractive force imposed by stream ice cover.

Project Objectives

- Develop a consistent procedure to determine how to adjust the HEC-11 stability factor to allow for ice forces on stream bank protection.
- Specify the riprap size with a greater degree of confidence and to potentially reduce the amount of material that stable stream banks require.
- Expand the HEC-11 procedure only to allow for the presence of river ice. The hydraulic engineer or designer will still need to develop the flow, channel, and ice information.

Project Status

Research executed a contract in September 2001. The contractor should have results early in April or May 2002. A report will be available at the end of this project, which should be September 30, 2001. Direct questions and comments to Clint Adler, Project Manager, at 907-451-5321 or clint_adler@dot.state.ak.us.

A Quick Slope Stability Analysis With Seepage

(Part 2 of 3 parts)

From *Hawaiian Connections* Volume 3, no. 3 fall 2001, newsletter of the Hawaii LTAP

Editor's Note: Walter Lum, consulting engineer, has developed quick and easy ways to solve complex problems through many years of experience. He has shared his rules of thumb with us.

Slope stability analysis can be performed very quickly by the following semi-graphical procedure, if the slope and slip surfaces are known and drawn to scale.

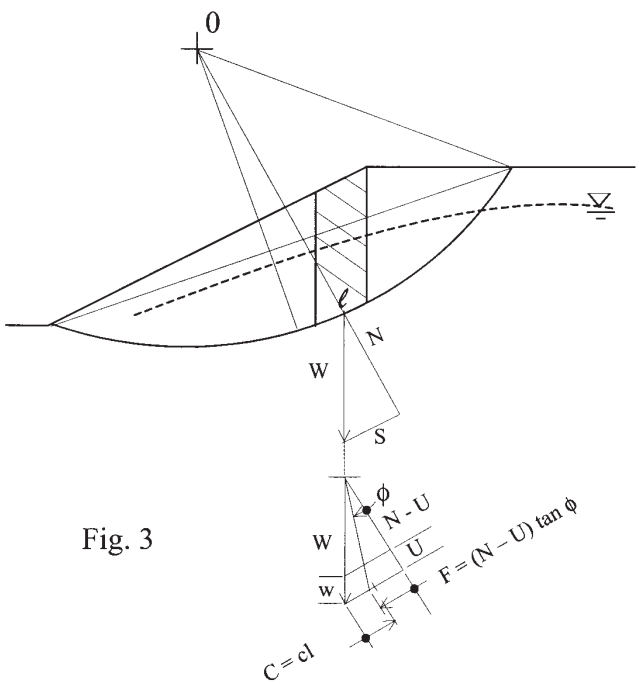


Fig. 3

Given: c = cohesion

ϕ = friction angle

γ = unit weight of soil

For F.S. = Factor of Safety of a Slice, Fig. 3

W = weight of slice

N = normal through the origin "0"

S = shear required for equilibrium

w = weight of seepage water

U = water force

C = c x l = cohesion available

F = (N - U) x tan ϕ = friction available

F.S. = (C + F) / S

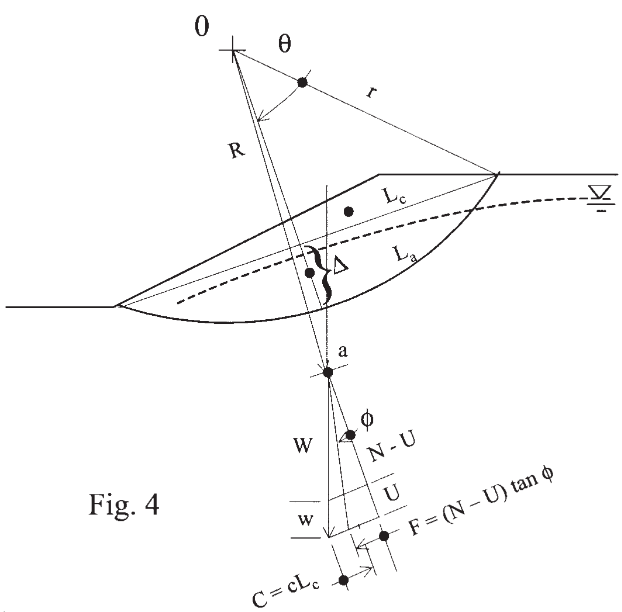


Fig. 4

For F.S. = Factor of Safety of total Slope, Fig. 4

Begin force polygon at point "a", the intersection of weight W and radius R

R = r x L_a/L_c, $L_a/L_c = \theta$ / (57.3 x sin θ)

W = weight of triangle and circular segment (weight of segment = γ x Δ x L_c x 0.68)

w = weight of seepage water

U = water force

F.S. = [c x L_c + (N - U) x tan ϕ] / S

F.S. = (C + F) / S

Check it out with a known problem and see, it works!

Visions of Snow Fences and Anti-Icing Danced in Their Heads . . .

LTAP recently concluded a round of winter maintenance training around Alaska. Don Walker of the Wisconsin Local Technical Assistance Program conducted six workshops covering anti-icing, deicing, and abrasives. Walker, who has spent his career staying on top of the state of the art in winter maintenance, discussed both road and airport applications. Workers in Juneau, Anchorage, Palmer, Valdez, Fairbanks, and Kenai learned about a multitude of chemicals, the temperatures at which those chemicals perform best, relative costs, and how to plan for snow and ice control activities. They also had the opportunity to ask questions and share their own experiences.

Ron Tabler, an international expert on wind and snow, taught three sessions of snow fence design and installation. Knowing snow properties and how the wind behaves over different terrain helps designers and maintenance workers choose where best to install snow fences to keep roads from drifting shut over the course of a winter. Jim Adams from Nome, who is responsible from DOT&PF's Western District, and George Levasseur from Valdez, who has the same responsibilities for the SouthCentral District, co-instructed with Tabler. Both have experience with snow fences in their respective areas and shared their knowledge with the participants. Classes were held in Nome, Fairbanks, and Palmer.

Ten years ago, workers for the Matanuska-Susitna Borough and some of their contractors attended Alaska LTAP's first two-hour snow fence workshop in Palmer. They were enthused enough to try the technology. Leif Kopperud, then a contractor and now a Road Superintendent for the Borough, and Richard Stryken, Road Superintendent, report they were able to reduce their snow clearing budget significantly by installing snow fence. One of their local roads, Drift Lane, had drifted shut at least once each winter since 1935. The year the snow fence went in, the road remained open year-round, to the delight of Fred and Sarah Machetanz, who live on the road. Over time, the borough installed about five miles of fence, using 4' vertical slats instead of the much taller horizontal slats, mostly due to right of way constraints. They work with farmers to put the

continued on next page

Nome-Council Road Snow Fence

Ron Tabler, right front, speaks with participants of the Palmer snow fence design sessions.

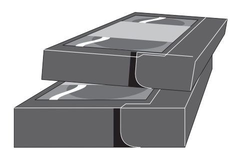
fences in their fields in the fall, and then pick the fences up each spring. Even the shorter fences buy a lot of time for the road crews when the wind picks up – especially at night. And understanding how drifts form helped the borough to plan their snow clearing activities to avoid backdrifting. Essentially, they avoid putting the snow where the wind works against them.

Nome-Council Road at Mile 6, March 25, 1994.

Snow fence, looking west-northwest. March 22, 1998.

Frost pushed up the north side rebar anchors. Snow was over four feet deep on the north side. March 25, 1998.

New Videos from T2 Training Library



Comparable Concepts for Replacement Housing 12 minutes, and ***Business Relocation:*** These videos discuss subject matter contained in 29 CFR Part 24.

Safety for Adopt-A-Highway Volunteers: This video was produced and tailored for the Alaska program. 10 minutes.

Noteworthy: ***Uniform Act Interactive Tutorial:*** The interactive tutorial was designed to provide you with a basic understanding of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (as amended). The tutorial is an executable file and will run on any PC equipped with a Windows operating system and a mouse. It will not operate on PCs equipped with Apple/MacIntosh operating systems. http://www.fhwa.dot.gov/realestate/uaintro.htm

Click, Listen & Learn Programs Sponsored by the American Public Works Association (APWA) and LTAP APWA's audio-web conferences offer a new, cost-effective way of learning and sharing information through the use of tools sitting on your desk: a telephone and a PC with web access. Listen to the speakers through your telephone, and view the visual presentation via the web. Programs average two hours long and include printed speaker handouts and feature live Q&A. Participate from your desk, or in a group setting by connecting through a conference/speaker phone and projecting the web image upon a screen. http://www.ltapt2.org/events.htm

Alaska LTAP - T2 will host all of the APWA Click, Listen, & Learn sessions for interested Alaska cities and boroughs. Contact Sharon at 907-451-5323, sharon_mcleod@dot.state.ak.us or Simon at 907-451-5482, simon_howell@dot.state.ak.us.

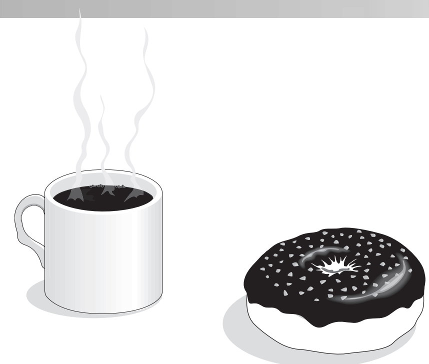
Anticipated 2002 Training

The following lists training that LTAP and NHI currently anticipate presenting in Alaska. There will be additions or deletions as the year progresses.

- Grader Operator Finish training, summer; Anchorage, Fairbanks, Mat-Su, Glennallen, Juneau
- Beginning and Intermediate Grader Operator Training, summer; Anchorage, Fairbanks, Mat-Su, Soldotna, Nome, Kotzebue, Kodiak, Cold Bay, Dillingham, Prince of Wales Island, King Salmon , and Juneau
- NHI 38060, Work Zone Traffic Control for Maintenance Operations on Rural Roads; Anchorage, Juneau, Palmer
- Safety Features for Local Roads—When to Use Permanent Traffic Control Signing, spring; Anchorage, Fairbanks, Soldotna, Mat-Su, Juneau
- GASB 34—how to inventory and value existing infrastructure components, asset management, and identifying appropriate accounting practices; multiple locations
- CAT Equipment Training: Machine Application/ Performance Seminar. Ties the engineering component to the machine component
- Alaska Traffic Manual/New MUTCD workshops; multiple locations
- APWA Click, Listen, & Learn Programs, 2 hours each; multiple locations
  1. March 5: Cutting Through the Dust: Dirt & Gravel Road Maintenance, Pennsylvania LTAP
  2. April 24: Using Gut-Level Emotion to Make Safety Training Stick, Michigan LTAP
  3. May 21: Conflict Solving for the New Supervisor, Louisiana LTAP
  4. July 17: Implementing GASB 34; What it Could Mean for you, William J. Mobbs, P.E.
  5. October 29: Effective Use of Chemicals & Abrasives for Winter Road Maintenance, Wisconsin LTAP
  6. December 5: Risk Management & Tort Liability on Roadways—What you Need to Know to Protect Your Agency, West Virginia LTAP
- ATSSA Traffic Control Technician Training, Traffic Control Supervisor, and train-the-trainer workshops teaching trained technicians and supervisors to become flagging instructors; Anchorage, Fairbanks, & Juneau
- Writing Clear, Concise Letters and Reports—the Murawski Group; Anchorage, Fairbanks, & Juneau
- NHI 142005, NEPA & Transportation Decision Making; Anchorage
- NHI 142007, Fundamentals & Abatement of Highway Traffic Noise; Anchorage
- NHI 130048, Seismic Design & Retrofit of Highway Bridges; Juneau
- Conflict Resolution & Environmental Public Policy Decisions; Anchorage
- Introduction to Geometric Design; Anchorage
- CAT Paving Seminar; Anchorage
- Effective Roadway Lighting course by University of Wisconsin-Madison; Anchorage
- Construction Cost Estimating Pilot; Fairbanks
- Asphalt Laydown Workshop; Palmer
- Polymers & Emulsions Workshop; Anchorage
- Effective Negotiating II; Fairbanks & Anchorage
- AASHTO Leadership Training; Anchorage
- Management Training for DOT&PF employees; Anchorage, Fairbanks, Juneau
- Boom Truck Fall Protection, Anchorage

For information about T2 sponsored training, contact: Sharon McLeod-Everette at 907-451-5323; sharon_mcleod-everette@dot.state.ak.us or Simon Howell at 907-451-5482; simon_howell@dot.state.ak.us, or to to www.dot.state.ak.us, go to "World of DOT & PF," then click on "Training Opportunities."

Meetings & Events 2001



Meetings Around Alaska

Society	Chapter	Meeting Days	Location & Contact
ASCE	Anchorage	Monthly, 3rd Tues., noon	Northern Lights Inn
	Fairbanks	Monthly, 3rd Wed., noon	Captain Bartlett Inn
	Juneau	Monthly, 2nd Wed., noon*	Westmark Hotel * except June–Aug.
ASPE	Anchorage	Monthly, 2nd Thurs., noon	West Coast International Inn
	Fairbanks	Monthly, 1st Fri., noon	Captain Bartlett Inn
	Juneau	Monthly, 2nd Wed., noon*	Westmark Hotel * except June–Aug.
ASPLS	Anchorage	Monthly, 3rd Tues., noon	Executive Cafeteria, Federal Building
	Fairbanks	Monthly, 4th Tues., noon	Ah Sa Wan Restaurant
	Mat-Su Valley	Monthly, last Wed., noon	Windbreak Cafe George Strother, 745-9810
AWRA	Northern Region	Monthly, 3rd Wed., noon	Rm 531 Duckering Bldg., University of Alaska Fairbanks Larry Hinzman, 474-7331
ICBO	Northern Chapter	Monthly, 1st Wed., noon	Zach's Sophie Station Jeff Russell, 451-5495
ITE	Anchorage	Monthly, 4th Tues., noon**	Sourdough Mining Co. Alex Prosak, 562-3252 ** except July & Dec.
IRWA	Sourdough Ch. 49	Monthly, 3rd Thurs., noon**	West Coast International Inn
	Arctic Trails Ch. 71	Monthly, 2nd Thurs., noon**	Oriental House
	Totem Ch. 59	Monthly, 1st Wed., noon	Mike's Place, Douglas ** except July & Dec.
PE in Government	Anchorage	Monthly, last Fri., 7 a.m.	Elmer's Restaurant
Society of Women Engineers	Anchorage	Monthly, 1st Wed. 6:30 p.m. except July and August	varies Karen Helgeson, 522-6513

GIS, GPS Focus

Editor's Note: We selected four key articles that appeared in sequential issues of WST2—Washington State Technology Transfer, Washington Department of Transportation and the Local Technical Assistance Program technical newsletter. We are focusing this issue on GPS, GIS, Asset Management, and GASB 34. We opted to do so based on discussions with Alaska's cities and boroughs over the past year. We think these articles offer good information, even though they sometimes refer to details in Washington, or to previous articles. To read other issues of WST2, go to http://www.wsdot.wa.gov/TA/T2Center/T2hp.htm.

As a Delta II rocket lifts off in the late 1990s with a global positioning satellite on board, we step back from Earth to get the big picture for GIS data. Photo courtesy of Boeing.

This newsletter is funded by the Federal Highway Administration and the Alaska Department of Transportation and Public Facilities. The material contained herein does not necessarily reflect the views of the Alaska Department of Transportation, Federal Highway Administration, or the T² staff. Any reference to a commercial product or organization in this newsletter is only for informational purposes and is not intended as an endorsement.

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